



Reply

Reply to Sanfilippo et al. Caution Is Warranted When Assessing Diastolic Function Using Transesophageal Echocardiography. Comment on “Kyle et al. Consensus Defined Diastolic Dysfunction and Cardiac Postoperative Morbidity Score: A Prospective Observational Study. *J. Clin. Med.* 2021, 10, 5198”

Mateusz Zawadka^{1,2,3,*,†} , Bonnie Kyle^{1,†}, Hilary Shanahan⁴, Jackie Cooper², Andrew Rogers¹, Ashraf Hamarneh¹ , Vivek Sivaraman¹, Sibtain Anwar^{1,2,5} and Andrew Smith¹

- ¹ Perioperative Medicine, Barts Heart Centre, St. Bartholomew’s Hospital, London EC1A 7BE, UK; bonnie.kyle@nhs.net (B.K.); dr.amrogers@gmail.com (A.R.); a.hamarneh@ucl.ac.uk (A.H.); m.t.zawadka@gmail.com (V.S.); s.anwar@qmul.ac.uk (S.A.); andrew.smith84@nhs.net (A.S.)
 - ² NIHR Biomedical Research Centre, William Harvey Research Institute, Barts, Queen Mary University of London, London E1 4NS, UK; jackie.cooper@qmul.ac.uk
 - ³ 2nd Department of Anesthesiology and Intensive Care, Medical University of Warsaw, 02-091 Warsaw, Poland
 - ⁴ Department of Anaesthesia and Critical Care, Papworth Hospital NHS Foundation Trust, Papworth Everard, Cambridge CB2 0AY, UK; hshanahan@nhs.net
 - ⁵ Outcomes Research Consortium, Cleveland Clinic, Cleveland, OH 44195, USA
- * Correspondence: mzawadka@wum.edu.pl; Tel.: +44-485-992-002
† These authors contributed equally to this work.



Citation: Zawadka, M.; Kyle, B.; Shanahan, H.; Cooper, J.; Rogers, A.; Hamarneh, A.; Sivaraman, V.; Anwar, S.; Smith, A. Reply to Sanfilippo et al. Caution Is Warranted When Assessing Diastolic Function Using Transesophageal Echocardiography. Comment on “Kyle et al. Consensus Defined Diastolic Dysfunction and Cardiac Postoperative Morbidity Score: A Prospective Observational Study. *J. Clin. Med.* 2021, 10, 5198”. *J. Clin. Med.* **2022**, *11*, 3300. <https://doi.org/10.3390/jcm11123300>

Academic Editor: Vanessa Bianconi

Received: 9 May 2022

Accepted: 6 June 2022

Published: 9 June 2022

Publisher’s Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

We thank Sanfilippo and colleagues for their insightful comments about the assessment of diastolic function with transesophageal echocardiography (TEE) [1]. In our investigation [2] we used the current guidelines for assessment of diastolic function by the American Society of Echocardiography (ASE) and the European Association of Cardiovascular Imaging [3]. Although yet to be formally validated for the assessment of left ventricular diastolic dysfunction (LVDD), TEE continues to be used in clinical practice both in the operating theatre and ICU. The ASE recommend TEE for evaluation of LVDD as part of an ongoing intraoperative study [4,5], accepting the fact that this may be prone to unavoidable inaccuracy [6].

Of note, we outlined our process of diagnosis and grading of LVDD in “Appendix 3: Process of Evaluating DD”. Within those known limitations, our results showed that trying to follow the guideline allowed characterisation of most of the studied patients. Regarding the issues raised against the use of left atrial volume index (LAVI) and tissue Doppler imaging (TDI), we take this opportunity to further clarify the process.

Firstly, 30% of patients had depressed ejection fraction and, thus, a diagnosis of diastolic dysfunction existed by definition, independently from intraoperative assessment. Secondly, we agree with Sanfilippo and colleagues that the LAVI measurement is flawed in TEE due to the anatomical difficulty of fully visualizing the left atrium (LA). However, in most patients, satisfactory images of the LA were obtained ($n = 107$) and then used to calculate the LAVI. Moreover, even if the diagnosis of mildly increased LAVI can be challenging with TEE, it is relatively easy to identify a severely dilated LA and to use this in the assessment of LVDD [5]. As clinicians, we have to accept the flaws of the measurements and be aware of the limitations.

Thirdly, considering the results of the study by Mauermann [7] and colleagues, we are aware of the possible underestimation of relaxation (e'), but as suggested by the authors, this difference is modest and probably not clinically relevant, being in the region of 0.6 cm/s. Therefore, the impact on LVDD is unremarkable from a pragmatic perspective.

A different aspect suggested by Sanfilippo and colleagues was the adherence to the PRICES guidelines for reporting critical-care echocardiography studies [8]. Although

we agree that following these guidelines could strengthen the study and make it more comparable with future studies, it is also true that the PRICES project was preceded by a systematic appraisal of the literature [9], which excluded the cardiac surgery setting. Although prospective, our study enrolled patients undergoing cardiac surgery from November 2014 to December 2016, years before the PRICES recommendations were issued. For these reasons we did not collect and thus report several data deemed essential by the PRICES recommendations.

When conducting ultrasound research, it is also vitally important to acknowledge variability in different learning pathways and ensure standardisation of competences [10–14]. Critical-care echocardiography research, due to its limitations (critically ill patients, time sensitive exams and patients' heterogeneity), tends to be low volume and a comparable reporting system would further strengthen the field and provide more robust findings. Research in an intensive care setting can be especially challenging as most of the available guidelines refer to the general public and its application to different populations might be controversial. There is a need for a collaborative and multicentered effort in critical-care echocardiography to provide enough high-quality evidence to build guidelines for this very specific population.

Author Contributions: Conceptualization, M.Z and B.K.; methodology, J.C. and B.K.; formal analysis, M.Z. and B.K.; investigation, B.K., H.S., A.R., A.H. and A.S.; writing—original draft preparation, B.K., A.S. and M.Z.; writing—review and editing, B.K., M.Z., A.S., S.A. and V.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

- Sanfilippo, F.; La Via, L.; Messina, S.; Lanzafame, B.; Dezio, V.; Astuto, M. Caution Is Warranted When Assessing Diastolic Function Using Transesophageal Echocardiography. Comment on Kyle et al. Consensus Defined Diastolic Dysfunction and Cardiac Postoperative Morbidity Score: A Prospective Observational Study. *J. Clin. Med.* **2021**, *10*, 5198. *J. Clin. Med.* **2022**, *11*, 3105. [[CrossRef](#)]
- Kyle, B.; Zawadka, M.; Shanahan, H.; Cooper, J.; Rogers, A.; Hamarneh, A.; Sivaraman, V.; Anwar, S.; Smith, A. Consensus Defined Diastolic Dysfunction and Cardiac Postoperative Morbidity Score: A Prospective Observational Study. *J. Clin. Med.* **2021**, *10*, 5198. [[CrossRef](#)] [[PubMed](#)]
- Nagueh, S.F.; Smiseth, O.A.; Appleton, C.P.; Byrd, B.F.; Dokainish, H.; Edvardsen, T.; Flachskampf, F.A.; Gillebert, T.C.; Klein, A.L.; Lancellotti, P.; et al. Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *Eur. J. Echocardiogr.* **2016**, *17*, 1321–1360. [[CrossRef](#)]
- Sanfilippo, F.; Johnson, C.; Bellavia, D.; Morsolini, M.; Romano, G.; Santonocito, C.; Centineo, L.; Pastore, F.; Pilato, M.; Arcadipane, A. Mitral Regurgitation Grading in the Operating Room: A Systematic Review and Meta-analysis Comparing Preoperative and Intraoperative Assessments During Cardiac Surgery. *J. Cardiothorac. Vasc. Anesth.* **2017**, *31*, 1681–1691. [[CrossRef](#)]
- Hahn, R.T.; Abraham, T.; Adams, M.S.; Bruce, C.J.; Glas, K.E.; Lang, R.M.; Reeves, S.T.; Shanewise, J.S.; Siu, S.C.; Stewart, W.; et al. Guidelines for performing a comprehensive transesophageal echocardiographic examination: Recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. *J. Am. Soc. Echocardiogr.* **2013**, *26*, 921–964. [[CrossRef](#)] [[PubMed](#)]
- Sanfilippo, F.; Scolletta, S.; Morelli, A.; Vieillard-Baron, A. Practical approach to diastolic dysfunction in light of the new guidelines and clinical applications in the operating room and in the intensive care. *Ann. Intensive Care* **2018**, *8*, 100. [[CrossRef](#)] [[PubMed](#)]
- Mauermann, E.; Bouchez, S.; Bove, T.; Vandenneuvel, M.; Wouters, P. Assessing Left Ventricular Early Diastolic Velocities with Tissue Doppler and Speckle Tracking by Transesophageal and Transthoracic Echocardiography. *Anesth. Analg.* **2021**, *132*, 1400–1409. [[CrossRef](#)] [[PubMed](#)]
- Sanfilippo, F.; Huang, S.; Herpain, A.; Balik, M.; Chew, M.S.; Clau-Terré, F.; Corredor, C.; De Backer, D.; Fletcher, N.; Geri, G.; et al. The PRICES statement: An ESICM expert consensus on methodology for conducting and reporting critical care echocardiography research studies. *Intensive Care Med.* **2021**, *47*, 1–13. [[CrossRef](#)] [[PubMed](#)]
- Huang, S.; Sanfilippo, F.; Herpain, A.; Balik, M.; Chew, M.; Clau-Terré, F.; Corredor, C.; De Backer, D.; Fletcher, N.; Geri, G.; et al. Systematic review and literature appraisal on methodology of conducting and reporting critical-care echocardiography studies: A report from the European Society of Intensive Care Medicine PRICES expert panel. *Ann. Intensive Care* **2020**, *10*, 49. [[CrossRef](#)] [[PubMed](#)]

10. Rajamani, A.; Galarza, L.; Sanfilippo, F.; Wong, A.; Goffi, A.; Tuinman, P.; Mayo, P.; Arntfield, R.; Fisher, R.; Chew, M.; et al. Criteria, Processes, and Determination of Competence in Basic Critical Care Echocardiography Training: A Delphi Process Consensus Statement by the Learning Ultrasound in Critical Care (LUCC) Initiative. *Chest* **2022**, *161*, 492–503. [[CrossRef](#)] [[PubMed](#)]
11. Wong, A.; Galarza, L.; Duska, F. Critical Care Ultrasound: A Systematic Review of International Training Competencies and Program. *Crit. Care Med.* **2019**, *47*, e256–e262. [[CrossRef](#)] [[PubMed](#)]
12. Wong, A.; Galarza, L.; Forni, L.; De Backer, D.; Slama, M.; Cholley, B.; Mayo, P.; McLean, A.; Vieillard-Baron, A.; Lichtenstein, D.; et al. Recommendations for core critical care ultrasound competencies as a part of specialist training in multidisciplinary intensive care: A framework proposed by the European Society of Intensive Care Medicine (ESICM). *Crit. Care* **2020**, *24*, 393. [[CrossRef](#)] [[PubMed](#)]
13. McIlroy, D.R.; Lin, E.; Hastings, S.; Durkin, C. Intraoperative Transesophageal Echocardiography for the Evaluation and Management of Diastolic Dysfunction in Patients Undergoing Cardiac Surgery: A Survey of Current Practice. *J. Cardiothorac. Vasc. Anesth.* **2016**, *30*, 389–397. [[CrossRef](#)] [[PubMed](#)]
14. Flower, L.; Dempsey, M.; White, A.; Sanfilippo, F.; Olusanya, O.; Madhivathanan, P.R. Training and Accreditation Pathways in Critical Care and Perioperative Echocardiography. *J. Cardiothorac. Vasc. Anesth.* **2021**, *35*, 235–247. [[CrossRef](#)] [[PubMed](#)]